

DEVELOPMENTS IN THE COTTON INDUSTRY *

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WE are here on this occasion to review the progress that has been made in the prevention of accidents that occur through the flammability of fabrics. And although there may be some who view the situation with alarm, and insist that not enough progress has been made, I should like to state at the outset my feeling that, within the framework of the free-enterprise system under which we live, definite strides have been taken in the past 25 years toward minimizing—although admittedly not eliminating—this kind of accident. And I should like further to call attention to the role of the cotton industry in the progress that has been made in this respect.

The cotton industry has made significant contributions to the development of fire-resistant finishes. Representatives of the cotton industry helped to perfect the clothing-flammability test without which there would be no legislation on the flammability of textiles. The industry cosponsored and supported the Flammable Fabrics Act; today, people of the cotton industry are participating actively in every effort to provide consumers with greater protection from the dangers of fire.

This problem of fire safety has three separate aspects that I should like to have you think about with me for a little while. The first of these is the situation involving unusually hazardous fabrics: such items as brushed-rayon torch sweaters, cowboys' chaps on playsuits, nitro-cellulose-coated fabrics, filmy nettings, etc. These are fabrics that are so dangerous that they should be eliminated from the market. The proscription of these fabrics was the task that Congress set itself in 1953. Let me quote to you a portion of Report No. 425 of the House

*Based on a paper presented at the *Conference on Burns and Flame-Retardant Fabrics*, held at The New York Academy of Medicine, December 2 and 3, 1966. The conference was sponsored by: the New York and Brooklyn Trauma Committee of the American College of Surgeons, Chicago, Ill.; The National Fire Protection Association, Boston, Mass.; the Section on Plastic and Reconstructive Surgery of The New York Academy of Medicine; and the Division of Accident Prevention of the U. S. Public Health Service, Washington, D. C. The conference was held in cooperation with the American Academy of Pediatrics, Evanston, Ill.; the American Public Health Association, New York, N. Y.; and the National Safety Council, Chicago, Ill.; and was supported by a grant from the U. S. Public Health Service.

of Representatives on H. R. 5069, the bill that later became the Flammable Fabrics Act: "The major problem in formulating legislation to control the use of dangerously flammable textiles is to discriminate between the conventional fabrics that present moderate and generally recognized hazards and the special types of fabrics which present unusual hazards and are highly dangerous." This, in essence, is the philosophy of the Flammable Fabrics Act: "...to discriminate between... conventional fabrics... and fabrics which present unusual hazards..." And in this the Flammable Fabrics Act has done its job admirably.

The second aspect of safety from fire with which we should be concerned is that involving hazardous, or potentially hazardous, situations or occupations, such as those of steel workers, military pilots, and others. Here we have a somewhat different and much more complicated problem. The danger from a hazardous *fabric* such as a "torch sweater" is that an accident can be caused by a tiny flame or other minor source of ignition. In a hazardous occupation a relatively slow-burning fabric would not necessarily prevent an accident, because the source of ignition could be overwhelmingly large or long-continuing. Thus for protection we require not merely nonpropagation of flame, we need also a barrier that will protect a man from a flame or source of ignition that may well impinge on him for a long time. The best answer to this problem is cotton treated with fire-retardant finishes. This treatment ensures not only that the fabric will not support combustion but that it will maintain a barrier of char for protection of the substrate—in this case a human body. And there has indeed been increased use in recent years of durably treated cotton fabrics used in protective clothing.

The third aspect of this whole problem of fire safety involves the extension of protection to clothing and fabrics considered to be of normal flammability and used under normal circumstances but which, through an element of carelessness, may still cause accidents. This is a problem still unsolved: one that will require more research and close cooperation between safety-minded organizations and the textile industry.

Almost all textile fibers are combustible to some degree and, if exposed to flame through carelessness, may cause injury by burning or melting. And although the Flammable Fabrics Act has been entirely successful in eliminating from the market particularly hazardous fabrics such as those used in torch sweaters, there are certain inadequacies to the test method as presently used.

In the first place, the test suffers from lack of *precision*. While it is perfectly capable of differentiating between fabrics that differ widely in their flammability characteristics—and this, to be sure, is what the test was designed to do—its ability to make finer distinctions is subject to question. The inherent variability in the test method and in the fabrics themselves can lead to erroneous conclusions.

There is also some question about the *validity* of the test, i.e., are we measuring in all cases what we think we are measuring? Fabrics that in everyone's opinion are completely safe are sometimes eliminated from commerce because of the failure of the test to provide adequate discrimination of flame intensity. For example, I am aware of instances in which two lightweight fabrics both burned rapidly—one with a small flame in less than $3\frac{1}{2}$ seconds, the other with a large flame in slightly more than $3\frac{1}{2}$ seconds. The latter was undoubtedly a more dangerous fabric, but it passed the flammability test.

Conversely, the lack of a method for testing narrow fabrics and loose fibrous materials may well allow some dangerous materials to be used. These shortcomings are now under study. New procedures for testing narrow fabrics and loose fibrous materials have been devised, and they are now being evaluated. Some research has also been done by the National Bureau of Standards on the measurement of flame intensity, but this is a complicated subject, and we are far from a solution for it.

Another shortcoming of the test method is its failure to take into account elements of hazard other than flaming. There are certain fabrics that resist flame propagation; but they do it by melting and falling away. It can easily be seen that such a thermoplastic fabric could lead to serious injury when used in apparel; burns occasioned by adherence to the skin of heated fibers could be as much hazard as flaming.

Now let us look at the subject of fire-retardant finishes. Chemical treatments to prevent the burning of textile fabrics have been with us for a long time. Simple nondurable treatments with such mixtures as borax and boric acid are still used today where properties such as hand and stiffness are not critical and durability is not needed. But it is obvious that for most textiles we need a treatment that is durable and that has no effect on other properties of the fabric or garment. The closest we have come to this is using organic phosphorus compounds such as THPC,* based on the work of U.S. Department of Agriculture scien-

*Tetrakis (hydroxymethyl) phosphonium chloride.

tists back in the early 1950's. And so, at present, we do indeed have finishes that are suitable for certain applications—outdoor fabrics, certain household fabrics, and a few specialized clothing items. But in general these finishes are deficient in hand, texture, absorbency, and other properties important in apparel. These deficiencies are particularly apparent when finishes are applied to lightweight fabrics in which the need is probably greater. Their effect on fabrics is to a large extent a result of the tremendous add-on (frequently 20 to 22 per cent) needed to produce resistance to flame, and this large add-on results also in high chemical cost, which makes the treated garments in many cases too expensive to be acceptable to consumers.

And so, although we have made some definite progress in protecting the public in the United States against injuries involving hazardous fabrics in normal situations, and normal fabrics in hazardous situations, we now must face the problem of normal fabrics in normal situations. What solutions can we offer? None, I am afraid. About all we can do at this time is to list what we might need in order to find the solution: information, education, and research.

First, there is a great dearth of factual information on the subject of injuries from burns involving clothing—and I want to stress my use of the word *factual*! There is entirely too much *misinformation* being bruited about in the guise of fact. Unfortunately, the whole subject of injuries from burns is too fraught with emotion. There is no one, regardless of his private interests, who would not take any measures necessary to prevent a particular child from being injured in a particular accident. But at the risk of seeming insensitive, it behooves us to take a dispassionate look at the true facts about the flammability of fabrics.

Fabrics do burn. And people wearing garments made of fabrics do suffer injuries from burns. But whether a particular fabric, as used in a particular garment, bears any responsibility for the injury, is a much more complicated question. Statistics are cited on accidents “involving burning clothing.” But “involving” cannot be taken as equivalent to “caused by.” The person who is seriously burned because he was sprayed with flaming oil by an exploding heater would have been injured had he been wearing asbestos, or armor plate, or nothing at all.

For example, let me quote from a study made several years ago of accidents involving burns. This was “An Investigation of Fabrics In-

volved in Wearing Apparel Burns, by the Committee on Accident Prevention, American Academy of Pediatrics, and the Committee on Wearing Apparel, National Fire Protection Association.” Both these groups are sponsors of this conference. Case No. 5 states that a “slip being worn by 12-year-old girl while she lighted an oil-fired range ignited when range exploded”; Case No. 6 says, “. . . shirt tail of 44-year-old man became moistened with range oil while he was cleaning the kitchen range. Shirt tail ignited when he went to the basement and opened the door of coal-fired furnace”; and Case No. 56 describes how a “19-year-old girl spilled fuel oil on nightgown when she got up to light oil stove. Ignition occurred when she bent down with match to light stove.”

Surely no one could honestly assume that the fabric—whatever it was—was at fault in these cases. And surely no investigation of these fabrics could produce any information that would be of much value in a study of injuries from burns involving textiles. And surely any compilation of injuries that included a significant number of cases like these would be a weak weapon with which to indict “hazardous” clothing textiles.

I understand that the Public Health Service of the U.S. Department of Health, Education, and Welfare is presently working on a study of injuries from burns in which an attempt will be made fully to assess the causes, major and minor, of these accidents. It is my fervent hope that from this study we shall be able to obtain information on which to base future work in this area.

The second major need that I cited is for education. Education of consumers directed at reducing the carelessness that causes accidents could undoubtedly reduce injuries and save lives; but it probably is not the ultimate solution to the problem of flammable clothing. And while this is an area in which the cotton industry cannot take the lead—there are other groups far better qualified—we certainly want to offer our cooperation to any of these groups in any of their activities.

The third great need is for research—to develop improved fire-resistant finishes, at lower cost, with minimum effect on other fabric properties and, if possible, with other added benefits that consumers find desirable. The cotton industry has definite plans for increased research in this direction. A decision has already been made by the Cotton Producers Institute of this city to place a large contract with a

well-known research organization for the development of improved methods for producing fire-retardant cotton fabrics.

The U.S. Department of Agriculture has a long record of successful accomplishments in this area on behalf of cotton, and it will, I am sure, continue to produce significant advances.

It would seem that, in addition, the situation might offer an important opportunity for research by the chemical industry. If a treatment could be developed that would solve the problem of the flammability of fabrics, with no effect on other properties of fabrics and garments, and with an add-on of perhaps 5 per cent on the weight of the goods, the potential market might be as much as 2 billion yards a year—depending on the cost of the treatment—which would consume some 25 million pounds of chemical—a tidy market, I should think, for any company or group of companies.

The cotton industry stands ready to offer its full cooperation to the fire-safety groups represented here or to anyone else, in making any practical approach to the problem of providing greater protection to the public in the United States.